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GOLD AND SILVER CUSTOM PLANTS

BY

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DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

GOLD AND SILVER CUSTOM PLANTS[1]

By E. D. Gardner[2]

A custom gold and silver plant is one that treats ores for a fee. Usually such plants are located in mining districts and treat local ores. Ores of milling grade generally can stand only moderate transportation charges. These plants are scattered throughout the West. Most plants now doing a custom business originally were built by mining companies to handle ores from their own mines. As excess mill capacity became available ores from neighboring properties were treated, mainly as an accommodation. Later, as their own ore bodies became depleted, the mills were operated entirely on a custom basis. A few plants pull ore from their own mines only when the supply of custom ore is insufficient to keep the mill operating. Some of the present custom plants were built for custom work alone. Although built originally to treat the ores of the Golden Cycle mine, the Golden Cycle plant at Colorado Springs, Colo., soon became a custom mill and has been operating successfully for many years. It is the largest gold mill in the Western States and treats Cripple Creek ores, from which most of its tonnage still comes. The plant is equipped to treat a great variety of ores and receives shipments from a wide area. It competes with smelters in Colorado, as it has a roasting plant to prepare sulphide concentrates for treatment in its cyanide plant. Most custom mills, however, are not adapted for more than one or two kinds of ore.

Gold occurs in its ores both in the metallic state (free) and locked up in sulphides. It also occurs in a few places, notably at Cripple Creek and a few other Colorado districts, as tellurides. When the gold occurs in the native state, the ores is said to be free-milling and can be recovered by amalgamation. Usually, however, some subsidiary treatment is required to make a satisfactory extraction. Amalgamation generally was followed by tabling in the earlier mills; at present, flotation has replaced tables at many places. As depth is reached in mining and the workings extend below the oxidized zone the character of the ore usually changes, or, as the miners say, "it gets base". Since the advent of flotation, the average recovery of gold in base ores has been improved greatly. Cyanidation is applied to some types of both gold and silver ores. The recovery by cyanidation is in general considerably higher than by other methods in vogue and in addition has the advantage of making a finished product which can be sold directly to the mint, thus obviating smelting charges on concentrate and discounts on the price of gold made by the smelting companies. The disadvantage of cyanidation is a higher first cost of plant and a higher operating cost.

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[1] The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgement is used: "Reprinted from U. S. Bureau of Mines Information Circular 6842."

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Silver seldom occurs in the native state in this country, and silver ores are not amenable to amalgamation; other methods for treating gold ores are equally suitable for silver. Most gold ores contain some silver, and silver ores usually contain some gold. Generally a higher recovery is made of the gold than the silver in ore containing both metals. Although at most gold mines associated metals are relatively unimportant, base metals in silver ores may constitute a large part of their value. There are very few mines in the United States in which the values are almost entirely silver. Lead and copper mines are the most important producers of silver.

The following table shows the gold and silver custom mills in the Western States in operation at the time of field trips by the author in 1933 and 1934.

It will be noted from the table that the total daily capacity of 30 of the 31 mills listed is 3,689 tons. Some of the mills, however, were not being operated at near capacity. The capacity for individual plants is 5 to 2,000 tons per day. Custom charges ranged from $1.75 to $9.60 per ton for ores, depending upon the character of the ores treated, the method used, and to some extent what the traffic would bear. Clean-up charges on small lots ranged from $5.00 to $15.00. At many of the smaller plants amalgam and concentrate were turned over to the shipper for marketing. The recovery at some of these plants was as low as 50 percent. Other companies paid for the ores eceived at 80 to 96 percent of its assay value; the higher brackets were at cyanide plants. Flow sheets ranged from straight amalgamation to amalgamation with tabling or flotation to straight cyaniding. Except at the Golden Cycle Mill lead, copper, or other base metals which might be contained in the ore are not paid for.

Since the field trips were made some of the mills listed have closed, and others have opened for business. Moreover, other mills not listed have begun to take custom ores. Many districts where the custom mills are situated are served adequately by these plants. Some of the small plants, however, were constructed poorly and run by hit-or-miss methods.

In a number of gold-mining districts gold-ore deposits are being discovered the mineral content of which does not warrant expenditures on development work, as there is no mill in the vicinity where the ore can be concentrated, and no single property has enough ore developed to warrant building a mill. These districts offer opportunities for the local miners and property owners to cooperate in the erection of custom mills and thus encourage mine developments on deposits that are valueless without local means for concentration and gold extraction.

A list of a number of custom mills in Arizona, California, Colorado, Nevada, and New Mexico and details as to the rates and deductions for treatment of gold ores and concentrates are given in the following table. This list does not include all of the mills in these States or those in Wyoming, Utah, Idaho, and other Western States. It is believed, however, that the publication of this partial list will be of interest to many.

Original from THE OHIO STATE UNIVERSITY

Mill	Date	Location	Capacity, ton Daily total	 Availab for cus ores
Tom Reed	1934	Oatman, Ariz.	300	150
Big Jim	1934	do.	50	10
Katherine	1934	Chloride, Ariz.	200 ?	125
Congress	1934	Morristown, Ariz.	100	100
Forester	1934	Salome, Ariz.	5	5
Hillsboro	1934	Hillsboro, N. Mex.	10	10
Golden Cycle	1934	Colorado Springs, Colo.	2,000	2,000
St. Joe	1934	Boulder, Colo.	67	40
Watrous	1934	Silver Plume, Colo.	30	
War Dance	1934	Blackhawk, Colo.	25	25
Farr	1934	do.	45	45
Argo	1934	Idaho Springs, Colo.	150	150
Gilpin	1934	do.	50 ?	50

1/Am stands for Amalgamation; Tb, Tabling; R, Cloth
Miscellaneous ores. 5/Miscellaneous ores: $19.50 up
50 percent, 1 to 5 oz.; 65 percent, 5 to 10 oz.; 75
first 5 oz., 92-1/2 percent of difference for second

m rates		
ication	Per ton.	Remarks
v lease.	$3.50 4.50	90 percent of gold at $33 oz. and 90 percent of silver at $0.60 oz. paid for. No deduction for moisture.
.00 ore $15.00.	4.50 4.50 to 6.00	90 percent of gold at $33 oz. and 90 percent of silver at $0.60 oz. paid for. No deduction for moisture.
e.	3.50	Amalgam and concentrate delivered to shipper. $15 clean-up charge for each lot.
mine y.	-	Milling cost, $1.46 ton.
.	2.00 4.00	Shipper given bullion and paid 70-percent heads to cy. $5 clean-up charge for each lot.
te.	11.00	Concentrates only treated.
	-	-
ts. ts.	3.00 2.50	Shipper given amalgam and concentrate.
	-	-
	-	-
lots.	3.00	-
e.	4.00	Clean-up charge of $10 for all lots under 10 tons. Shipper given amalgam and concentrate.
	2.40	-
lots. lots.	1.75 2.00	Clean-up charge of $15 on all lots under 75 tons. Tailings, stamp mill purchased on 50-percent assay value.
	-	-
	4.50	-
e.	6.00	-
	-	-

Continued on page 4.

Western gold custom mills - Continued

s le tom	Type of mill[1]	Recoveries made, percent		Percentage of metals paid for		Custom rates		Remarks
		Gold	Silver	Gold	Silver	Classification	Per ton	
	Cy.	98	-	95	-	25-ton lots.	$4.00	-
						75-ton lots.	3.80	-
						100-ton lots.	3.60	-
	Cy.	98	-	95	-	Small lots.	4.00	-
	Cy.	-	-	96	33	100-ton lots.	5.50	-
	Cy.	-	-	95	-	Up to $10 ore.	3.50	-
						$10 to $15 ore. ($0.50 for each $5 increase)	4.00	-
	Am. & Fl.	80 ?	-	-	-	Flat rate.	5.00	Clean-up after each lot and wait for returns.
	Fl.	-	-	-	-	do.	2.50	do.
	Tb. & Fl. or R. & Cy.	88[4]	-	5/	6/	Up to $8 ore.	2.50	Milling cost, 1932 $0.5039. Added sampling charge of $5 on all lots less than 10 tons. $2.50 for each extra lot in car.
						$8 to $10 ore.	3.00	
						$10 to $40 ore.	4.00 to 5.50	
		-	-	92[7]	-	Up to $4 ore.	1.95	Freight, $0.60.
						$5 to $8 ore.	2.50	Freight, $0.75.
						$10 to $100 ore.	5.70 to 9.60	Includes freight.
	Am., Fl. & Tb.	92	-	85	50 to 90	Up to $8 ore.	2.50	
						$8 to $10 ore.	3.00	
						$10 to $40 ore.	4.00 to 6.00	
	Am., Tb. & Fl.	92½	-	-	-	-	2.25	Concentrate and bullion given shipper.
	Tb. & Fl.	-	-	-	-	Lots less 100 tons.	2.25	do.
						Lots over 100 tons.	2.50	
	Am. & Fl.					-	2.25	do.
	Tb. & Fl.	90	-	-	-	Up to $10 ore.	2.00	do.
						Over $10 ore. (Lots of 100 tons)	2.50	
	-	-	-	-	-	-	5.00	Clean-up charge of $5 for each lot.

, or riffles; Fl, Flotation; Cy, Cyanidation. [2] Being enlarged to 75 tons daily, September 1934. [3] Claimed. [4]
to 0.5 oz., $20 over 0.5 oz., plus 90 percent of difference mint price and $20.67. [6] None paid for under 1 oz.:
to 95 percent, 10 to 100 oz. [7] Cripple Creek ores: $20 oz. plus 95 percent difference mint price and $20.67 for
1.5 oz. and 90 percent of difference of all gold in product over 10 oz. per